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But the time was approaching, when neither temperance nor virtue could exempt him from the final lot of humanity. For a series of years, indeed, for the most part of his life, he had enjoyed good health, and time seemed slowly to diminish the vigour of his body, or weaken the exertion of his mind; but it was perceptible to those who were much with him, and what he often remarked himself, that fatigue became less supportable, and recruit of strength, in his annual retreats into Cheshire, was of late years more slowly acquired.

The firmest constitution, like the most perfect elastic, may be extended beyond the power of restoration. It was on the 12th day of December 1780 that he was seized with a suppression of urine, which no art could remove.

He was as serene as in perfect health; he endeavoured, indeed, to assume a degree of chearfulness, which was natural to him when well, and described his complaints, and their probable fatal termination, with a pious hope, "that he had not lived in vain, but in a degree to answer the end of his creation, by sacrificing interested considerations, and his own ease, to the good of his fellow-creatures." Some individuals might have envied the universal esteem he acquired by his virtues, his manners, and his skill in healing; and all may admire that comfort of mind which sustained him to his final dissolution, which was on the 26th day of December 1780.

A man so long, and so respectfully known, dying in the summit of celebrity, and surrounded with the caresses of a numerous acquaintance, must be deeply and universally regretted.

DISCOVERIES AND IMPROVEMENTS IN ARTS, MANUFACTURES, &c.

On the use of Iron for Stairs, and instead of the Timbers of Houses, as a Security against Fire. By Mr. Benjamin Cook.

Phil.Jour. vol. 21, *p.* 126.

IN a former paper in the Philosophical Journal, I threw out some loose hints on the advantage of employing iron in various articles of furniture, as a substitute for mahogany, and other expensive woods. I will now add to it a mode of substituting it in the place of oak, and other less expensive woods. The chief use I would recommend it for is in stairs and stair-cases, but especially in the metropolis, where so many fires are constantly happening, and where so many lives are annually lost by them; where so many plans have been devised for fire-escapes, and so few, if any, that have ever answered the end.

I have long wondered some plan has not been thought of, which provided security within doors, instead of waiting for precarious assistance from without. It is not so easy to introduce a remedy, such a remedy I am now proposing, into houses already built; either from a parsimoniousness of the owners, or from a fancied security in the idea, that with them there is no danger, and therefore they will not go to the expense of adding a new flight of stairs, which beside the expense, will be attended with much trouble and confusion. The other class, that are likely to hinder the adoption of the remedy, are those that are not able to go to the expense of the alteration. But these persons that could afford it, and wished to provide for the danger of fire, if a probable remedy was shown them, might certainly do it; and as houses are continually altering, and new ones constantly being erected, certainly it would decrease the evil, and be introducing, if but slowly, a system that in years would increase, and be of essential utility.

The remedy I mean is stairs and stair-cases, made either of cast and sheet iron combined, or cast iron only. The framing for the stairs, to which the boards are nailed in the present mode, might all be cast, and screwed together. Of course, this framing would be considerably lighter in appearance than if made of wood. The front and top of the step, if made of sheet iron, might be attached with six or eight screws to the cast iron framing; and in order to give it a neat finish, a light bevelled moulding might run all round the front of every step, and the jointings be neatly screwed to it with small screws, with heads countersunk into the mouldings.

But if the front and top of the steps were cast in plates, which I think the cheapest and easiest way, the framing might be cast with sunk edges, so that the front and top of the steps would just fit into the grooved framing, and four or six screws would fasten them in a few moments. All the tops and fronts, when cast in a mould, would fit in the framing; and all the framing being so cast to fit, a flight of stairs would soon be put together; the plates might all be cast light, and when all screwed together, would appear a handsome mass of iron.

They who are unacquainted with the method of casting may suppose, that the sand would leave the work rough and uneven; but, if it is cast in fine sand, it would be level and uniform, and be ready for screwing together; the surfaces will be as regular as stone, when put together, and not so liable to wear smooth, and endanger a person to slip off in coming down stairs. Such stairs will certainly be much handsomer than stone, and of half the price, or less: with this advantage, the railing may match, and be made of cast iron also.

They would appear very beautiful, if well painted, to imitate mahogany, as also the railing, which might be cast in very handsome, and various fanciful patterns. There would be much scope for genius and fancy in devising and executing the stair-cases and railings, as almost any device, almost any antique figure or gothic scroll, might be tastefully introduced, forming an elegant, indeed I might venture to say, if expense was not the object, the most beautiful, and certainly the most durable stair-cases, that can possibly be formed.

Common stair-cases of iron would certainly be made as cheap, or cheaper than of oak; and I think, if a manufactory was to be established, and a regular trade made of it, they might afford them as cheap as any kind of wood, and a great deal more work might be put in them, as far as concerns the ornamental part; for the same cast, that formed only straight lines, would, by varying the mould at the same expense, form the most beautiful specimens of antiquity. Therefore wood cannot be brought into comparison with it, on the score of taste, nor can price be admitted as an objection to its introduction. Besides, if painting was looked upon as an expense, they would always look well if brushed over with black lead; and, as all houses, except the houses of the lower orders, have carpets up the stairs, the tread would be quite as pleasant as on stairs made of mahogany; and in case of fire, a safe escape would always be ready. Dreadful must be the situation of those persons, who, waked by the cry of fire, rush to the landings, find the lower rooms are burning, the staircase blazing and falling, and no escape left but the dreadful one of precipitating themselves from a window, running the risk of being dashed to pieces, or of remaining in the house, to perish in the flames, when, if the staircase had been of iron, all might have escaped with little or no injury.

If iron was introduced for joists, rafters,and beams, they might all be cast hollow, they might all be screwed and pinned together, and have a very light appearance, at the same time possessing much more strength than wood. If the spars, on which the floor is laid, were made tight, and laid near each other, and cast with a small projecting edge on each side, at the bottom of each spar, so that, when laid down, to form the floor, a flat tile, or thin quarry, would just fit in between two spars; when all the interstices of the floor were filled up with cheap tiles or quarries made on purpose, the floor would be fire' proof, and made so at a very little expense; as the spars might be cast light, there being more in number, and would be nearly, if not quite as cheap as wood spars; and all the additional expense would be the common flat tiles, which would not be of much extra value, nor give much trouble in the laying, on which fire-proof floor the boards might be laid.

By the introducing of iron for timber, the danger of fire would be much less to be dreaded; for, if a room took fire, its contents and floor could only be destroyed, and the fire could not easily be communicated from room to room. Indeed I do not see how it is possible for it to extend. The large timbers, that now connect rooms together, would be taken away, which timbers being burnt through, the floor falls, and overwhelms in destruction the rooms and furniture below.

Floors could not fall in, if laid on iron; as only the boards on them could be burnt. Roofs could not fall in, if the beam, rafters, &c. were iron. In fact, a fire could not make its way and spread, if iron was substituted for the timbers now used in building, and few, if any lives would ever be lost, if stair-cases were made of iron also.

Birmingham. B. COOK.

Observations.

The many dreadful accidents which have happened from fire, would, it might be supposed, be sufficient to rouse mankind to some effectual measures to secure their dwellings from its ravages; but instead of the interest means for this effect should excite, the most marvellous apathy prevails, and many, on the contrary, seem to dare the devouring element, by preferring combustible substances for every possible application in and about their houses; some of which contain such large portions of timber in wainscots, partitions, stairs, floors, roofs, &c. that to those who consider the danger, they appear like the funeral piles of the ancients, only wanting a match to kindle the whole into flames, and prepare all the family at once for the sepulchral urn. We wonder at those who build their habitations on the sides of volcanoes; but is our indifference to a fiery exit much less than theirs, living as we do, at our ease, in such dangerously inflammable buildings?"

We think it therefore a duty to give Mr. Cook's paper at large on this subject, and to second his benevolent views by every means in our power, and shall therefore endeavour to procure calculations of the expense of stair-cases, &c. of cast iron, such as he proposes, to make it more evident, that obtaining security from such tremendous danger in this manner is not a dereliction of economy.

Several patents have been taken out for the application of cast iron to floors and roofs: Mr. Wyatt, and Mr. Dodd, of London, have had patents for this purpose; Mr. Norton, of Birmingham, has had one lately, and we could give a list of more, if it was any object to search the volumes which contain them. But we know of none that can impede the use of cast iron proposed by Mr. Cook.

Stone stair-cases are now erected in many of the new houses in London, which procure security so far; but there can be little doubt, cast iron stairs would cost less. It may perhaps be a satisfaction to some of our readers, to point out cast iron stair-cases, which have been many years in use, and may be seen at all times. There are two of this kind at the front of the duke of Queensbury's house, in Piccadilly, from the street to the balconies of the parlour windows: they are neatly executed, look very light, and have a good effect: they are open in front under each step, and seem to be supported by hammered iron bars, wrought to fit their inflections underneath. These short staircases might serve as models, till better should be designed. If it should be disagreeable to have them open beneath the step, though this adds greatly to the lightness of their appearance, plates of sheet iron will be strong enough to close that part; the top of the step alone need be of cast iron, the outward support may be either of cast or hammered iron, and the inner ends of the stairs may be sustained by the walls, in the same manner which stone stairs are. A light iron railing would look more uniform, though not absolutely necessary for safety, and the only part which would be best of wood is the hand-rail at the top. Paint would be preferable to black lead for securing at least the upper surfaces of the stairs from rust, as the latter would make them so very slippery, that it would be difficult to stand on them; a carpet or oil-cloth, would, however, remove this inconvenience.

The writer of this article recollects mentioning the use of tiles for flooring over iron rafters, both to Mr. Cook and to Mr. Norton, several weeks ago. They would form both secure and cheap flooring, but laying a wooden floor over them, as mentioned by Mr. Cook, is not absolutely necessary. Tiles may be prepared for floors at the British potteries, so as to be highly ornamental, either in single patterns for each tile, or so as that several will unite to form one design, which would look at least as well as a wooden floor, or if expense was no object, the floors might be of marble or white stone; where it was an object, the plain red tiles would do sufficiently well, and where carpets or oil-cloths are used, would be in all respects equal to the others. The tiles might be fastened to the rafters by screws with nuts underneath; most flooring tiles have holes in the corners, which would answer for this purpose; but at all events they might be easily formed with them. Indeed where tiles were used for floors, wooden rafters would cause little danger of fire, for only a long continued and strong fire over the tiles, would cause heat enough to inflame the rafters through them, but iron rafters would certainly be more secure. This method of forming floors, is, we understand, common in Paris, and other parts of France, as mentioned in the paper on providing employment for the labouring poor, inserted in our last number. Where wooden rafters are used, the tiles might be screwed to them by the common screws for entering wood, which would be better than nails, as the latter would be apt to cause the tiles to be broken in driving them.

Patent of James Grellier esq. of Barking, Essex, for a Building of a peculiar Construction for the purpose of Burning Coke and Lime. Dated Feb. 1809.

The body of the lime kiln is made of the usual form in Mr. Grellier's plan, and beneath it are placed chambers of the form of common coke ovens, in which the coal is burned separately from the lime and converted into coke; flues proceed from the coke ovens to the lime kiln, by which the heat is conveyed that calcines the limestone. These flues are either made to enter at the bottom of the lime kiln, "the lime being prevented from descending as low as the said bottom, or floor, by an arched grating or support made of iron bars, or of brick work or other proper material; or otherwise the flues communicate, through the sides of the lime kiln, so as to burn the stone which lies above the place of their entrance. In the first case the lime is drawn out through doors, or quarters made just above the iron grating; and in the last case the lime kiln, or chamber where the lime is burned, is continued several feet below the entrance of the flues; and the burned lime is drawn out in the same manner as is done in a common lime kiln. By these arrangements it is easy to charge the kiln with lime stone, and the coke ovens with coal repeatedly; and to draw out the coke, and the lime at the proper periods so as to continue the operations of coke making and lime burning continually during any length of time.

Mr. Grellier states finally that the lime kiln and coke oven may be made to good effect of various forms, yet he prefers coke ovens of an elliptical shape so disposed in the lower part of a circular building that the longest diameter of the ellipsis, may respectively lie in radii, in one of the horizontal sections of the said building; and that the mouths of the ovens may open externally, and the flues communicate internally with one lime kiln, having its axis perpendicular to the horizon, and coincident with the axis of the building itself.

Observations. It certainly is a grievous sight to any one who knows the value of fuel, to behold the enormous waste of it in the parts of England where coke is made. It is no exaggeration to say, that the heat which is there wasted would be